R E P O R T R E S U M E S

ED 015 138 SE 003 814

THE DEVELOPMENT OF NEW SUPPLEMENTARY TEACHING MATERIALS AND AN ANALYSIS OF THEIR POTENTIAL USE IN THE HIGH SCHOOL BIOLOGY CURRICULUM. FINAL REPORT.

BY- LEE, ADDISON E.
TEXAS UNIV., AUSTIN

REPORT NUMBER CRP-S-451 PUB DATE AUG 66
REPORT NUMBER BR-5-8449
CONTRACT OEC-6-10-171
EDRS PRICE MF-$0.25 HC-$0.40 8P.

DESCRIPTORS- *BIOLOGY, *INSTRUCTION, *INSTRUCTIONAL MATERIALS, *SCIENCE ACTIVITIES, *SECONDARY SCHOOL SCIENCE, AUDIOVISUAL AIDS, INQUIRY TRAINING, SCIENCE MATERIALS, TEACHING GUIDES, TEACHING TECHNIQUES, BIOLOGICAL SCIENCES CURRICULUM STUDY COMPREHENSIVE FINAL EXAM, PROCESSES OF SCIENCE TEST, DIFFERENTIAL APTITUDE TESTS, BIOLOGICAL SCIENCES CURRICULUM STUDY, UNITED STATES DEPARTMENT OF HEALTH EDUCATION AND WELFARE, HOUSTON, TEXAS

THIS PROJECT CONSISTED OF DEVELOPING AND TESTING MATERIALS DESIGNED TO TEACH THE PROCESSES OF SCIENTIFIC INQUIRY TO BEGINNING BIOLOGY STUDENTS. MATERIALS CALLED "SPRINGBOARDS FOR DISCUSSION" AND DESIGNED FOR PRESENTATION BY USING THE OVERHEAD PROJECTOR AND MAGNETIC TAPES WERE USED IN INSTRUCTION. MATERIALS OF THE FOLLOWING TYPES WERE DEVELOPED--(1) EXPERIMENTS, EITHER CLASSICAL OR CURRENT, WHICH ARE CENTRAL TO THE UNDERSTANDING OF CERTAIN TOPICS IN THE BLUE VERSION BIOLOGICAL SCIENCES CURRICULUM STUDY (BSCS) TEXTBOOK, (2) MAGNETIC TAPES MADE BY BIOLOGISTS WHICH DESCRIBE A PARTICULAR EXPERIMENT, EXPLAIN THE EVIDENCE FOR PRESENT-DAY UNDERSTANDINGS OF CERTAIN TOPICS, OR DESCRIBE THE PRESENT STATE OF KNOWLEDGE AND CHALLENGES IN A PARTICULAR AREA OF BIOLOGY. DATA COLLECTED CONSISTED OF PRE-SCORES ON THE PROCESSES OF SCIENCE TEST AND THE VERBAL REASONING AND NUMERICAL ABILITY PORTIONS OF THE DIFFERENTIAL APTITUDE TESTS. POST-SCORES OF THE PROCESSES OF SCIENCE TEST AND SELECTED ITEMS OF THE BSCS COMPREHENSIVE FINAL EXAMINATION WERE COLLECTED. THE DATA WERE ANALYZED BY AN ANALYSIS OF COVARIANCE IN WHICH THE PRETEST SCORES OF THE DIFFERENTIAL APTITUDE TEST WERE HELD CONSTANT AND THE SCORES OF THE POST-TEST BSCS ITEMS AND GAINS OF THE PROCESSES OF SCIENCE TEST SERVING AS THE DEPENDENT VARIABLES. TEACHER FEEDBACK WAS OBTAINED ON EACH "SPRINGBOARD FOR DISCUSSION." IT WAS CONCLUDED THAT THE "SPRINGBOARDS FOR DISCUSSION" WERE EFFECTIVE TEACHING DEVICES TO EMPHASIZE PROCESSES AND PROCEDURES OF SCIENTIFIC INQUIRY. THE PREPARATION AND USE OF SUCH MATERIALS AS THE "SPRINGBOARDS FOR DISCUSSION" APPEAR TO BE AN EFFECTIVE WAY OF IMPLEMENTING CHANGES IN TEACHING PATTERNS. (DS)

ED015138

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

BR 5-8449
PA 24

FINAL REPORT
Project No. S-451
Contract No. OE 6-10-171

THE DEVELOPMENT OF NEW SUPPLEMENTARY TEACHING MATERIALS AND AN ANALYSIS OF THEIR POTENTIAL USE IN THE HIGH SCHOOL BIOLOGY CURRICULUM

August 1966

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

SE 003 814

THE DEVELOPMENT OF NEW SUPPLEMENTARY TEACHING MATERIALS AND AN ANALYSIS OF THEIR POTENTIAL USE IN THE HIGH SCHOOL BIOLOGY CURRICULUM

Project No. S-451
Contract No. OE 6-10-171

Addison E. Lee

August 1966

The research reported herein was performed pursuant to a Fixed Price Contract with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

The University of Texas

Austin, Texas

INTRODUCTION

In recent years there has been unprecedented activity on a national scale to improve the curriculum materials for science teaching. These activities, involving scientists, educators, and classroom teachers, have resulted in the production of materials for courses in physics, chemistry, and biology at the high school level. Current efforts at the junior high school and elementary school level are underway and a number of materials are being developed. In each of the curriculum studies, materials were developed and tried out in classes. Feedback was obtained from the teachers and testing programs were conducted. Information obtained through teacher feedback and testing was used in the revision of materials, and after several years of trial and revision, the materials were published and are now available to classroom teachers.

The Biological Sciences Curriculum Study Committee (BSCS) developed many materials with a variety of approaches to the teaching of high school biology. Three basic textbooks differing in content and approach were developed, each organized around nine unifying themes.

One of these themes is scientific inquiry. The purpose of this study was to develop some new materials supplementary to the BSCS program but designed to help teach scientific inquiry to beginning students in biology.

METHOD

The approach used in this project was to develop a series of materials that were used to teach inquiry in high school biology classes which used the Blue Version BSCS textbook. The materials developed were called "Springboards for Discussion" and designed for presentation using the overhead projector and magnetic tapes. The following types were developed:

1. Experiments, either classical or current, that were central to the understanding of certain topics in the textbook.

2. Magnetic tapes recorded by biologists describing a particular experiment, explaining the evidence for present-day understandings of certain topics, or describing the present state of knowledge and challenges in a particular area of biology.

Each "Springboard for Discussion" included a student worksheet and a teacher guide. The materials developed and tested included the following:

Springboard Numbers	BSCS Blue Version Chapter	Title of Springboard
1.	1 General	Why Study Biology?
2.	1, Topics 8-9	Why Are There No Bluebonnets On Serpentine Soil?
3.	1, Topics 7-9	Is This A Living Fluid Infectant?
4.	3, Topics 1-2	What Causes This Selective Advantage?
5.	4, Topic 6	Is This A Case Of Spontaneous Generation?
6.	8, Topics 5-8	What Controls Cell Development?
7.	9, Topic 6	What Is A Source Of Carbon In Plants?
8.	10 General	Listen To Leaders In Science: Microbiology
9.	11 General	What Are Some Techniques Of Studying Cell Components?
10.	14, Topics 14-15	Does The Nucleus Change During Differentiation?
11.	14, Topics 14-16	Can Resting Cells Be Forced To Grow?
12.	14 General	Can Tumor Cells Produce Normal Cells?

Twelve "Springboards for Discussion" were completed and tested. These fitted in with the first semester of biology and covered the objectives and, in terms of broad definition, the topics originally planned for fourteen Springboards. A complete set of these "Springboards for Discussion" including the teacher guides, student worksheets, and audio and visual materials has been sent to the United States Office of Education under separate cover.

In each "Springboard for Discussion" the presentation was structured to elicit class discussion and to give the students vicarious experiences in the methods used by scientists. Students were asked to anticipate certain results, to interpret data, plan experiments to test hypotheses, or to criticize certain procedures. These responses formed the basis of class discussions and allowed the students to become acquainted with methods of scientists with evidence upon which certain present-day understandings are based.

Thus, the study included both the design and evaluation of materials in order to:

1. Provide students with activities that should enable them to better understand the processes of science.

2. Orient teachers of biology toward an approach to teaching that emphasizes student participation in the processes of inquiry.

3. Serve as models for materials which may be designed by the teachers to continue the teaching of inquiry.

Two high schools in Houston, Texas, were used as test schools for the materials. Both schools offered BSCS biology for the first time. Neither school had been involved in the testing program of BSCS materials. Both were located in areas of the city with approximately equal socio-economic levels. Qualified teachers from both schools were recommended for the study by the science supervisor. The sample included only those students taking the first semester of biology. Classes in one high school used the experimental materials developed, while classes of the other school served as a control group.

The data collected consisted of pre-scores on the Processes of Science Test and the Verbal Reasoning and Numerical Ability portions of the Differential Aptitude Tests. Post-scores of the Processes of Science Test and selected items of the BSCS Comprehensive Final Examination were collected.

RESULTS

The test data were analyzed by means of an analysis of variance, with scores on the Differential Aptitude Test serving as a concomitant variable and scores on selected items of the BSCS Comprehensive Final Examination and gains between pre and post tests of the Processes of Science Test serving as criterion variables.

The experimental group scored significantly higher on the Processes of Science Test ($P = <.01$) when scores on the Differential Aptitude Tests were held constant.

The control group scored significantly higher on the selected items of the BSCS Comprehensive Final Examination ($P = <.05$) when scores on the Differential Aptitude Tests were held constant.

Evaluation of the materials also included teacher feedback which was analyzed by the investigator. Teacher feedback was favorable and agreed generally with the analysis of the test data.

DISCUSSION

The test instruments selected permitted the acquisition of data concerning individual students and their progress in increasing subject competence as well as increasing an understanding of the processes of science. It should be recognized, however, that although those tests are considered among the best available at this time, they were not necessarily designed for this particular project. Thus, care must be taken in interpreting results indicated above.

It is probable that the greatest contribution this particular project has made has not been so much in the analysis of the results obtained but rather in the creative effort of developing some new kinds of teaching materials designed to fit a particular text. It should be recognized, however, that in some instances, the materials may be used independently or with other texts. Likewise, they can serve as models for development of other materials to accomplish similar purposes.

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

It was concluded that the "Springboards for Discussion" were effective teaching devices to emphasize processes and procedures of scientific inquiry. It should be noted that both the control group and the experimental group made gains as measured by pre and post tests of the Processes of Science Test. However, the relatively higher gains of the experimental group when scores on the concomitant variable were held constant probably reflect positive effects of the "Springboards for Discussion."

Although the "Springboards for Discussion" are considered effective teaching devices to emphasize processes and procedures of scientific inquiry, their use must be judiciously evaluated in relation to the other materials of the biology program. Less material can be covered with the "Springboards for Discussion" format than with lectures. This difference may well account for the relatively higher score of the control group on selected items of the BSCS Comprehensive Final Examination.

The preparation and use of materials such as the "Springboards for Discussion" appear to be an effective way of implementing changes in teaching patterns. The enthusiastic response by

teachers and the relative ease with which the materials were used support this idea.

On the basis of results obtained in the present study, it is probable that development and testing of materials--"Springboards for Discussion" developed here--organized with other BSCS versions or other biology programs could be developed and used successfully. To test this probability would be a possibility for additional investigations.

Some interest has already been expressed by officials of the Houston Public School System in exploring the possibilities of materials using the format of the "Springboards for Discussion" for slow learners. The development of such materials and subsequent evaluation of them is a possibility for additional research.

It is recommended that research be done to develop and evaluate similar models of supplementary teaching aids for other levels of study in biology as well as in other science disciplines or other academic fields.

Synchronized illustrations to accompany tapes might increase their effectiveness. The use of thirty-five millimeter slides might prove an inexpensive method of accomplishing this suggestion.

Many current experiments in biology would be interesting to biology students and might be adaptable to the format used in this study. It is recommended that other teaching aids of this type be developed.

SUMMARY

This project consisted of developing and testing materials designed to teach the processes of scientific inquiry to beginning biology students.

The approach used in this study was to create a series of materials which were used in high school biology classes that used the Blue Version BSCS textbook. These materials were called "Springboards for Discussion" and designed for presentation by using the overhead projector and magnetic tapes. Materials of the following types were developed:

1. Experiments, either classical or current, which are central to the understanding of certain topics in the textbook.

2. Magnetic tapes made by biologists which describe a particular experiment, explain the evidence for present-day understandings of certain topics, or describe the present state of knowledge and challenges in a particular area of biology.

The Springboards were used in one Houston high school and another Houston high school served as a control.

The data collected consisted of pre-scores on the Processes of Science Test and the Verbal Reasoning and Numerical Ability portions of the Differential Aptitude Tests. Post-scores of the Processes of Science Test and selected items of the BSCS Comprehensive Final Examination were collected. The data were analyzed by an analysis of covariance in which the pre test scores of the Differential Aptitude Test were held constant and the scores of the post test BSCS items and gains of the Processes of Science Test serving as the dependent variables. Teacher feedback was obtained on each "Springboard for Discussion."

It was concluded that the "Springboards for Discussion" were effective teaching devices to emphasize processes and procedures of scientific inquiry. The preparation and use of such materials such as the "Springboards for Discussion" appear to be an effective way of implementing changes in teaching patterns.